HORIBA

Fluorescence

Time-Resolved Electroluminescence with Fluorolog-QM

Application Note

Fluorolog-QM
FL-2024-12-4

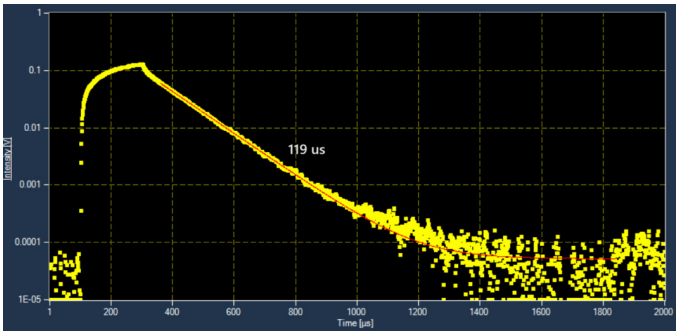
Introduction

Electroluminescence (EL) is the direct conversion of electrical energy into light through radiative recombination of holes and electrons in a material. This phenomenon is commonly seen in both inorganic semiconductors, like GaAs, and organic semiconductors (OLEDs), and it powers numerous lighting and display technologies due to benefits like low energy use, long life, and a wide range of color emissions. EL devices, such as LEDs and OLEDs, are increasingly used in medical, industrial, and environmental applications, creating a demand for tools capable of accurately characterizing their emission properties.

The Fluorolog-QM™ by HORIBA offers a robust solution for characterizing electroluminescent materials. With its modular design, this spectrophotometer can perform time-resolved EL (TREL) and basic steady-state measurements on EL samples without requiring additional external equipment. Here, we demonstrate how the Fluorolog-QM enables accurate TREL measurements over a wide range of lifetimes and supports steady-state EL spectra acquisition.

Methods and Results

Microsecond-Millisecond Time-Resolved Electroluminescence (TREL)

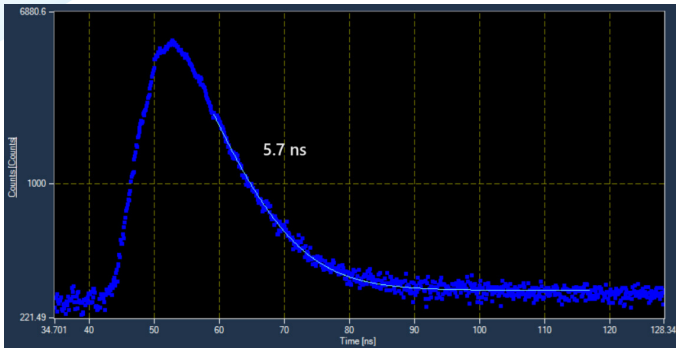


EL decay of sample 1 resulting in a lifetime of 119 µs

Using the ASOC-10 standard interface and Felix FL software, the Fluorolog-QM measures EL decay within a range of microseconds to milliseconds. By generating software-controlled electrical pulses, this setup enables rapid TREL measurements. The method is based on the Single-Shot Transient Digitizer (SSTD) technique, where each electrical pulse creates a complete decay measurement. The decay accumulation results in high-speed acquisition, with sample lifetimes obtained within seconds.

Example Result: Sample 1 demonstrated a decay lifetime of 119 µs, with data captured from 500 single-pulse decays within a 1-second experiment.

Expanding TREL to Nanoseconds-Seconds Range with TCSPC/MCS

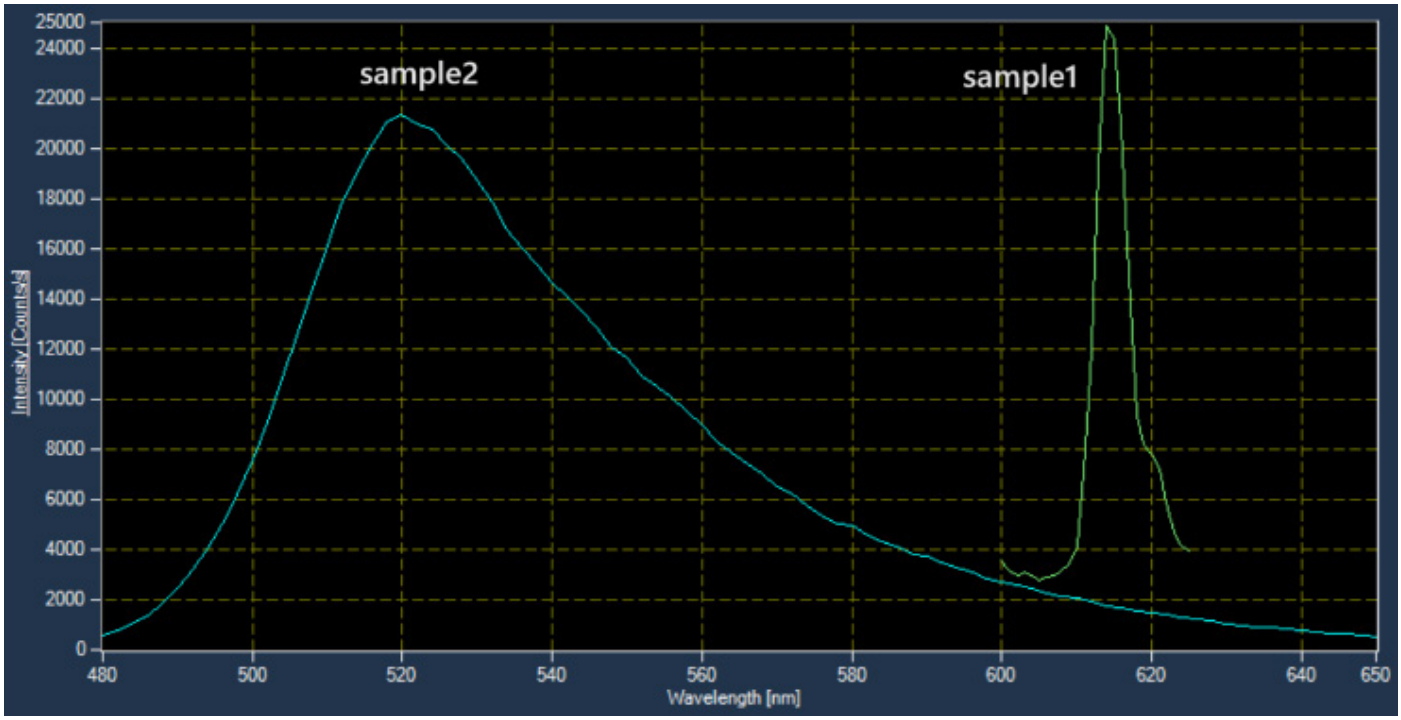


TCSPC EL decay of sample 2 resulting in a lifetimes of 5.7 ns

For applications requiring nanosecond-scale lifetimes, the Fluorolog-QM can utilize TCSPC (Time-Correlated Single Photon Counting) and MCS (Multi-Channel Scaling) with HORIBA's DeltaHub electronics and DeltaDiode controller. TCSPC provides resolution for short lifetimes, while MCS is used for lifetimes up to seconds.

Example Result: Sample 2 was measured at 5.7 ns using TCSPC, illustrating the Fluorolog-QM's sensitivity in the nanosecond range.

Steady-State Electroluminescence



EL-induced steady-state emission spectra of sample 1 and sample 2

Fluorolog-QM's steady-state EL measurement capabilities allow for basic emission characterization of EL samples. By utilizing its standard interface for a constant voltage output, the system performs steady-state measurements without requiring an external power source.

Example Result: Steady-state emission spectra for samples demonstrated distinct emission profiles, showcasing the instrument's ability to capture EL-induced spectra.

Conclusion

The Fluorolog-QM's advanced modularity supports the characterization of electroluminescent materials across a broad time range, from nanoseconds to seconds, without the need for external devices. With its built-in ability for TREL and steady-state measurements, this versatile system simplifies EL analysis in research and development of lighting, display, and other EL-based technologies. By expanding the lifetime range with the optional DeltaHub/DeltaDiode, the Fluorolog-QM stands as a comprehensive tool for exploring new EL applications in various scientific and industrial fields.

info.sci@horiba.com **www.horiba.com/fluorescence**

USA: +1 732 494 8660
UK: +44 (0)1604 542 500
China: +86 (0)21 6289 6060
Taiwan: +886 3 5600606
France: +33 (0)1 69 74 72 00
Italy: +39 06 51 59 22 1
India: +91 80 41273637
Brazil: +55 (0)11 2923 5400
Germany: +49 (0) 6251 8475 0
Japan: +81(75)313-8121
Singapore: +65 (0)6 745 8300
Other: +33 (0)1 69 74 72 00